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Paper Session II-B - Future Sustainable H2 Infrastructure

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Future Sustainable H_2 Infrastructure

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Abstract

The researchers hypothesized that it is possible to efficiently use an alternative energy source, rather than the combustion of hydrocarbons. The researchers found that the most efficient, abundant, environmentally friendly, reusable energy sources is Hydrogen. One of the most efficient methods of utilizing hydrogen was through the use of Proton Exchange Membrane Fuel Cells.

After thorough research into Proton Exchange Membrane Fuel Cells, or PEMFC's, the researchers constructed a working prototype of the fuel cell using easily obtainable materials. Many previous designs were studied and discussed. Newer designs were created to compensate for the use of easily obtainable materials. After a series of testing and redesigning, a high efficiency rating was achieved. The research supported the hypothesis made by the researchers and exceeded many of their expectations, despite the simple construction methods.

Background Information

"Waterworld," though a science fiction movie, could be a likely future for the world if we continue using current fossil energy conversion devices. Most modern energy supplying devices are in some way harmful to the environment and aid in destabilizing the delicate balance of nature.

It is estimated that the world has enough oil to last another fifty, maybe one hundred years. The United States oil reserve is estimated to be able to extend that between twenty-five and thirty years longer. This presents a rather important question: What happens when the world is out of oil?

Also, scientists estimate that at the rate humans are destroying the environment, in less than seventy-five years, the Earth will reach a point where it will not be able to recover from the damaged caused by the human disease. This means that if society remains blind to their own actions for another seventy-five years, the human race and all of Earth is doomed to a life in a polluted wasteland.

Many argue that the alternative energy sources available today are sufficient to power the world after petroleum is used up. This, however, is not true. Contrary to popular belief, after the world supply of oil is use up for electricity, the alternative energy sources available will be insufficient in power the world after the age of oil.

Also, most of the "clean" alternative energy sources today are not as "friendly" as the general population claims. Photoelectric power, ignoring the fact that it is inefficient and impractical, generates harmful chemicals in the production stages. Hydroelectric Power often destroy the habitats behind the dam after they are flooded with water. They also block the migration of fish, such as salmon, and the transfer of sediments, such as on

the Nile River. Nuclear Power Plants produce harmful radioactive wastes. This runs the risk either a radiation leak at the power plant or a leak at the disposal site. Wind power is also detrimental to the environment. The wind farms destroy large habitats and alter migratory patterns of birds. After considering these alternative fuel sources, it was obvious to the researchers that they were not the answer to the world's energy needs of the future.

The researchers concluded that not only does an energy source need to be clean and efficient, but it must also be abundant and re-usable. After thorough research and careful consideration, the researchers decided that Hydrogen would fulfill the needs of a clean, efficient, abundant, re-usable energy source.

Discussion of Purpose

The purpose of this project is to show that it is possible to have an alternative energy infrastructure that can replace the modern petroleum infrastructure that is currently in operation. Also, to show the world that this can be accomplished with easily obtainable, inexpensive materials. The researchers hypothesized that one of the ways the purpose can be fulfilled is through the construction of Hydrogen powered Proton Exchange Membrane Fuel Cells. They showed that the materials are easily obtainable because materials must be easily available for students to be able to gain access to them. Following the aforementioned procedure, the researchers constructed small fuel cells and tested their efficiency with a volt meter. Using this data, they organized this information into readable charts and graphs.

Experimental Procedure

First, the researchers researched the current energy infrastructure that is mainly based on pollution producing fossil fuels. Then, they researched alternative energy sources that are cleaner and more efficient than the existing energy infrastructures. From their research, the Researchers determined that the cleanest, most efficient renewable energy source would be hydrogen. Then they determined that the major setback in the conversion from Petroleum based to Hydrogen Based Infrastructures would be the cost. The ascertained that after 2nd generation production, the hydrogen fuel cell would be more cost effective than petroleum based energy sources and the high cost of conversion would be balanced by the relatively low cost of hydrogen fuel cells. Drawing from existing Proton Exchange Membrane Fuel Cell designs, the researchers designed a Fuel Cell using easily obtainable, inexpensive materials that would be as efficient, if not more efficient, than commercially available fuel sources. Finally, a series of proton exchange membrane fuel cells were constructed by the researchers based on their design concepts.

Conclusion

The researchers concluded through research and experimentation that it is possible to develop and construct a hydrogen fuel cell using inexpensive, easily obtainable materials that would have a output comparable to petroleum based energy conversion devices.